PROTECTIVE STRUCTURE FOR VEHICLES

The present invention refers to a protective structure for vehicles.

At present, the devices used on vehicles in order to limit damage during insurance or NCAP type crashes, on the front side, consist of completely metallic cross members, generally made of steel, positioned between the vehicle chassis and the bumpers; the cross member usually rests directly on and is fixed to the side members, or metal absorber devices (crash boxes), to which the cross member is connected, are fixed on the side members.

Said structures, however, do not guarantee good efficiency (understood as ratio between energy absorbed and crushing of the system) and, above all, since they have to deform to absorb energy and as they are shaped on the front strip of the bumper, the elements fixed to the side members tend to transmit high levels of stress (also in a tangential direction) on the side members thus obliging the user to adopt reinforcing devices, with consequent increase in the weight of the vehicle.

Furthermore, to adapt said structures to compliance with the requirements of the legislative proposals in the event of impact with pedestrians and, substantially, in the event of impact with the leg of

the pedestrian, it is necessary to further distance them from the bumper, positioning in this space absorber elements with pressures of between 0.1 and 0.6 N/mm^2, corresponding to a crushing of 50%.

Said absorber elements are generally made of foamed polypropylene, foamed polyurethane or foamed polystyrene.

In this case, however, the minimum space necessary for the installation of said absorber elements is approximately 80 mm + 30 mm (the 30 mm residual space being due to densification of the material which occurs during compression of the buffer and beyond which the compression forces are very high).

In short, the above-mentioned solutions are totally unsuitable or lacking in efficiency both to satisfy the regulations concerning impact between vehicles (in particular, the so-called insurance or NCAP type crashes) and to meet the requirements relating to pedestrian impact; furthermore, it is to be hoped that further additional systems will be provided in front of the bumper able to absorb energy during the impact, without requiring too much space between cross member and bumper.

The aim of the present invention is therefore to eliminate the above problems by producing a high-efficiency protective structure for vehicles, designed

to receive, in the event of impact with pedestrians, absorber buffers, at the same time obtaining a reduction in space (below or equal to 80 mm) between bumper and protective structure; the structure is also designed to comply with the minimum requirements of the current pedestrian impact regulations, with respect to traditional type protective structures.

a5 ~~This and other aims, according to the present~~ invention, are achieved by producing a protective structure for vehicles, ~~designed~~ to be used particularly ~~in~~ the event of impact with pedestrians, according to claim 1, which is here referred to for the ~~sake of brevity~~.

The characteristics and advantages of a protective structure for vehicles, designed to be used particularly in the event of insurance or NCAP crashes, according to the present invention, will be illustrated more clearly in the following description, intended as a non-restrictive example, referring to the attached schematic drawings in which:

a6 - figure 1 is a schematic perspective view of a front cross member of a vehicle used in known types of absorption structures;

- figure 1A is a schematic perspective view of a front cross member of a vehicle used in absorption structures for vehicles according to the present

invention;

- figure 2 is a plan view of the cross member of figure 1A, according to the present invention;

- figure 3 is a schematic side view of a cross member of known type, in which the effects of a crash are visible, in particular of an insurance crash;

- figure 3A shows a schematic side view of the cross member of figure 1A, according to the present invention, in which the effects of a crash are visible, in particular an insurance crash;

- figures 4 and 5 show a series of graphs relating to the time trend of the impact force and the energy absorbed by the systems, during the impact, and produced during a crash between a wall and 40% of the front face of a vehicle travelling at 15 km/h and provided with protective structures both of known type and of the type according to the present invention.

With reference to the figures mentioned, 17 indicates a front cross member for vehicles, shaped traditionally (in the particular case of figure 1, the cross member 17 is concertina-shaped), in order to absorb energy during a collision; cross member 17 is connected, also in a known way, to two side members or struts 22 of the vehicle.

The solution relating to the protective structure

for vehicles, subject of the present invention, features a front cross member, indicated by reference number 17A in figure 1A, modified with respect to the traditional cross members 17 as regards physical-geometrical structure and weight.

In particular, a cross member 17A is used, made of metal or plastic, preferably of the flat type, on which at least one first absorber element or buffer 16 operates, placed after the cross member 17A and positioned, in practice, between the vehicle bumper and the cross member 17A itself.

Alternatively a shaped cross member 17A can be produced from an extruded linear profile.

Alternatively a shaped cross member 17A can be produced by moulding and welding.

Furthermore, the cross member 17A can contain inside at least one second absorber element or buffer 25, in order to increase resistance to crushing of the cross member itself, without modifying its thickness, as said modification would lead to a considerable increase in overall weight.

Use of the buffer 25 furthermore permits consequent improvement in performance from the point of view of energy absorption during impact.

The resulting structure is illustrated overall in figure 2 and provides for the use of buffers 16

(arranged after and outside the cross member 17A, on the bumper side of the vehicle) made of materials having pressure values equal to approximately 5-30 N/mm^2 at 50% crushing; in this regard, plastic honeycomb (especially the injection-moulded material XENOY® by General Electric) or aluminium honeycombs or sheet metal crash boxes are used preferably, among others, as absorbing materials.

The absorber elements or internal buffers 25 can furthermore have characteristics such as to obtain pressures of 5-30 N/mm^2 corresponding to a crushing of 50%; also in this case, plastic honeycomb, and especially the injection-moulded material XENOY® by General Electric, or aluminium honeycombs or sheet metal crash boxes are used preferably, among others, as absorbing materials.

The absorber elements 16 are usually positioned laterally with respect to the cross member 17A in order to leave a central space for housing further possible absorber systems such as buffers for pedestrian impact.

Furthermore, the particular position of the buffers 16 means that, especially during a crash at moderate speed, they are the only ones to be damaged, with positive consequences in terms of saving on spare parts and skilled labour.

The solution described above provides excellent

performance on the entire vehicle; in particular, extremely good test results were obtained, in terms of sensitive parameters, in the case of an insurance crash.

The graphs of figures 4 and 5 firstly highlight that, while the solution described provides a reduction in mean force values with respect to traditional cross members (and this creates less tension on the vehicle structure), greater energy absorption is obtained by the system described, with respect to the known systems, during the impact, by using a modified cross member 17A, according to the invention (curves NT and ENT), instead of a traditional cross member 17 (curves T and ET).

Figures 3 and 3A illustrate a further advantage of the absorption structure subject of the invention.

More in particular, the flat or slightly shaped configuration of the cross member 17A according to the invention (fitted also with shaped bumpers in which the curves, shaped like the outer buffers, are very marked) permit minimisation of the tangential thrust produced on the side members 22 during the impact.

Figure 3, which is an example of deformation of a traditional type of cross member 17 during impact, shows how the current shaped cross member deforms during impact, but without modifying its initial length

which, due to its shape, is greater than the distance between the two side members.

This produces a lateral thrust on the side members 22, forcing them to open out completely corresponding to area 18; on the other hand, figure 3A, which refers to the same test as figure 3 and uses a cross member 17A according to the invention, shows the complete deformation of the cross member 17A and the impact energy absorption by the elements 16 and 25, without this producing a strain that cannot be withstood by the struts 22.

It has therefore been demonstrated that, by modifying the currently used front cross member 17 of the vehicle and fitting a different one as regards geometrical shape, overall structure and weight, the test results for the parameters concerning insurance or NCAP type crashes are extremely positive; furthermore, there is a gain in terms of overall dimensions of the entire structure, as good energy absorption values are obtained with a system, according to the invention, that occupies a length, in front of the side members 22, of 1 cm less than the known type of system.

Therefore installation of the front cross member 17A permits the insertion of extremely efficient absorber devices, in particular for pedestrian impact, and does not require the bumper to be moved forward

excessively, with respect to the traditional structures, as the entire area in front of the cross member outside the area of the buffers 16 permits housing of said absorber devices; furthermore, the height of the buffers 16 is exploited for compacting of the same in order to obtain good results also in the event of pedestrian impact.

From the description provided, the characteristics of the protective structure for vehicles, designed to be used particularly in the event of insurance or NCAP crashes and (using specific buffers) pedestrian impact, according to the present invention, are clear as are the resulting advantages.

In particular they are represented by:

- easy to simultaneously satisfy the various regulations concerning impact at various speeds (in this regard, excellent results are obtained in the event of pedestrian impact, insurance or NCAP type crashes at high speed);

- high absorption capacity in the event of an insurance crash, at average-low speeds, for any impact direction;

- limited weight and overall dimensions of the entire absorption structure;

- limited costs owing to the advantages achieved.

Finally, it is clear that further modifications and variations can be made to the protective structure for vehicles in question, all falling within the context of the inventive idea, and likewise it is also clear that the materials and dimensions illustrated can be varied according to technical requirements.